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THE UTILIZATION OF THE ELEMENTS OF INVENTICS THEORY OF COMBINATION FOR THE GROWTH OF QUALITY OF DIDACTIC DEMARCHE IN TECHNOLOGICAL EDUCATION

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ABSTRACT

The paper presents aspects regarding the quality system in education, the problem bonded to the improvement of quality, accessible directly for teachers, at the level of didactic practices. It is presented, in the technological education, proper interdisciplinary approach concept of technology, computer science and creativity, as well as the proper application methodology, using the elements of inventics theory of combinations, respectively morphological matrices of ideas. It is also presented, structure of the formation ensembles and application examples.
The paper highlights the growth of the quality system in education by simultaneous interdisciplinary approach of technology, creativity and computer science in technological education.

KEYWORDS: technological education, inventics, creativity, computer science.

1. INTRODUCTION

Scientist’s preoccupations in the domain of *morphology* and *combinatory* are very old because of the high creative potential.

The *morphological matrices* are one of the most performance ways, instruments, methods of structuring, systematization, classification, generation, combination, evaluation and selection of the used information in science and technology [11].

The data and information which can be presented in the morphological matrices have a general character, because of the possibility of content abstraction, and thus can be used in various domains.

In the educational domain, the modularizations of the studied disciplines content favor the use of this method in the research of new educational solutions.

2. ASPECTS REGARDING THE IMPROVEMENT OF QUALITY IN TECHNOLOGICAL EDUCATION

The quality represents all the features and characteristics of a product or service which determines its capacity of satisfying needs expressed or implied of the beneficiary.

The educational quality is the ensemble of characteristics of a study program of it’s supplier by which are satisfied the expectations of the direct and indirect beneficiary of educational services and requests of quality standards [12].

The systemic approach of quality in education means taking in consideration of the product quality (knowledge, competences, aptitudes, and the student’s attitudes) and of the didactical process quality (good practices, requests, actuality, efficacy/ efficiency) as an interface which is perceived in the educational, economic and social environment, Fig. 1 [9].

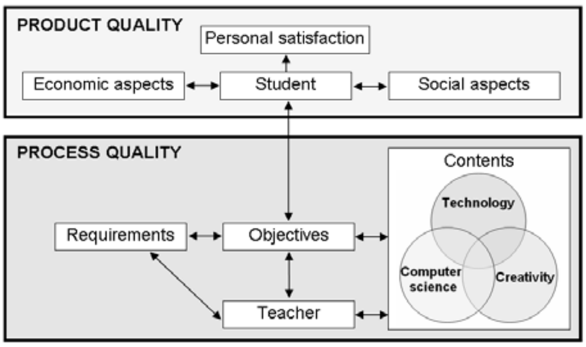

Fig. 1. Graphical model of representation of the product’s and the educational process quality [9]

Proper SR ISO 8402: 1995, by *improving quality* it is understood the actions made in the entire organization for the growth of efficacy and efficiency of the activities and processes for the purpose of ensuring improved advantages as well as for the organization and its clients [6].

Developing the problem of *improving quality,* on the basis of specialty literature, there are two ways of making the improvements and innovations in education: the *educational reform* and *pedagogical change*. In the case of the second option, accessible directly to the teacher, it can be operated at the level of knowledge system, practices and didactical ways or combinations of those.

The preoccupation for *restructuring the content/ objectives* is a constant practice in the domain of perfecting the education.

In paper [5], it is presented the development of a *generalized theory, systemic*, which could lead to a possible harmonization of the education in nowadays program, which consists of vertically separated blocks, in a new curriculum, having as structure: extended mathematics, system theory and applications Fig. 2 [5].

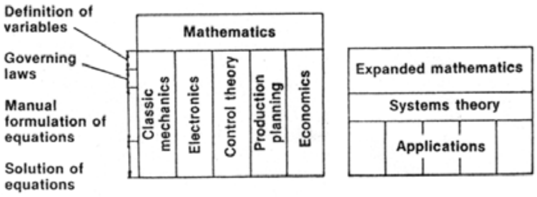

Fig. 2. The structure of today's and of the future curricula [5]

A similar structure expressed in percentage, for the engineering curriculum which contains design – electronic – mechanic is presented in paper [13], and in paper [1] it is presented a model of transforming the content in knowledge and skills with the help of didactic activities by sequencing of didactical unities based on facts, procedures, concepts and principles.

3. USE OF COMBINATORY INVENTICS ELEMENTS IN TECHNOLOGICAL EDUCATION

Problems regarding preparation, evaluation of the learning process after quality criteria, efficacy and its forming effect in the student's memory sphere, thinking, imagination, motivation, attitude can not be resolved scientifically unless with a systemic, global and unitary approach of all the personality components (cognitive, affective, psychological) and of the learning process (objectives, contents, methods, ways, material frame, relationships) having in mind as well as the entry elements and the output elements.

Moreover, preoccupation for making the information volume in a continuous growth neglects in many cases the tasks of making attitudes with negative implications in the graduate's profile of formation.

The proper model of interdisciplinary integration of creativity and computer science in technological education, designing the program for the optional discipline and didactical technology which has in view realization of some aptitudes, competences, attitudes and a knowledge system which learned can be used in different contexts have been presented in paper [9].

Modular approach of the content is a modern tendency in nowadays educational practices which present advantages and opportunities for the structuring of the knowledge system in the technological domain.

The proposed methodology defines more explicit of the *knowledge system,* starting from modular organization of knowledge by elaborating *forming ensembles* that have study themes obtained thru multiples content combinations. The elements that define this forming ensembles are:

– Objectives: operational objectives from educational plan or resulted from study context, $O = \{O_1, O_2, ..., O_i\}$;

– Technology: area for interest from technology, raw materials, energy, products or different technological area (construction machinery, mechanical working, chemical, textile industry, electronics), $T = \{M_1, M_2, ..., M_j\}$;

– Computer science: object programming, data base, utilities programs, educational software, Internet, $I = \{P, DBF, PU, SE, W\}$;

– Creativity: heuristic, logical-heuristic and logical the methods, techniques, procedures, demarches, algorithms which can applied to creative stimulation of students, $C = \{E, LE, L\}$.

Adjacency matrix for the system of knowledge is presented in the Table 1.

Table 1. General matrix of forming ensembles

	$T_1 I_1 C_1$	$T_2 I_2 C_2$	...	$T_j I_k C_n$
O_1	X			
O_2				X
...				
O_i		X		

For those elements that exist concrete conditions of application (marked with X in the Table 1), it is made a detail (Table 2) so it can be determined the nuances, refinement or aspects of study/ research interests, objectives and competences derived can be evolved.

Those developments can be applied for every forming ensembles, by example:

– forming ensemble *T* (technology), T_1 (metal technology), M_1 (module 1, materials), M_{1a} (copper);

– forming ensemble *I* (computer science), *DBF* (databases), DBF_1 (parameters), DBF_{1a} (density);

─ forming ensemble *C* (creativity), *E* (heuristic methods), E_1 (brainstorming), E_{1a} (write-brainstorming).

Table 2. Detail matrix of forming ensembles

	$M_{1a}DBF_{1a}E_{1a}$	$M_{1b}DBF_{1b}E_{1b}$	...	$M_{1j}DBF_{1k}E_{1n}$
O_{1a}		X		
O_{1b}	X			
...				
O_{1i}		X		

4.1. Realizing of the forming ensembles in the technological domain

We consider that the structuring of the knowledge system to the technology which we propose in paper [10] in nowadays context of globalization contains prime matter, materials, technologies, products, energy, marketing, management, quality, environment, design, technology with approach priorities over the information technology, unconventional technologies, nanotechnology, biotechnology.

The realization of the forming ensembles in the technology domain can start from the *modular conception of technical systems* which are a theme considered a *resource of creativity* in specialty works.

For the *study/ research of technical systems* and realization of forming ensembles in the technological domain, we present the method elaborated by the teacher N. Gherghel, after the model A. I. Polovinkin for the hierarchical description of technical systems in general and technological devices, Fig. 3 [7].

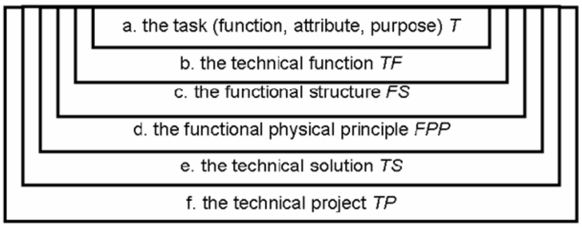

Fig. 3. The stages/ description levels/ elements of the hierarchical description of technological devices' hydraulic action [7]

In the modular approach of technological domains it can be taken in consideration as well the *functional-constructive-technological structure of the technical creation object OCT* [3] named *FCT model* (*F* – function, *C* – construction, *T* – technology).

For the study/ research of prime matter, materials, and realization of forming ensembles and modular approach in the material science there can be taken in consideration *compositional parameters x*, *structural parameters s*, *technological parameters t*, and *properties y* (physical, mechanical, chemical, technological). In the scientific research it can be seen the determination of some correlation of type [2]:

$$(y_1, y_2, \dots, y_p) = f(x_1, x_2, \dots, x_i). \quad (1)$$

4.2. Realizing of the forming ensembles in the computer science domain

Even if it is a relative new science, computer science has numerous theoretical branches and practical-applicative ones. Moreover, it can be seen that research directions in the computer science directions are becoming integrated parts in other domains (bio-computer science, mecatronic).

Realization of forming ensembles from the computer science domain can be made by dividing some modules which have in view the sub-domains of this science and the instruments/ specific methods which can be used interdisciplinary with the technological domain for study/ research: operating, programming, database use, internet use, educational software. There can be individualized modules for:

─ knowing and correct use of office software (Word, Excel, Access, PowerPoint);

─ the use of databases (by the level of students, FoxPro, Oracle, public/ educational databases);

─ the use of programming (there can be used the Turbo Pascal, C++, C#, Java);

─ the use of educational software (commercial, or made by teachers for a specific theme);

─ Internet use (accessing needed information, website design, educational partnership);

─ understanding, defining and the correct use of the notions: data, information, knowledge;

─ exercises of hardware/ software configuration for the optimization of systems.

4.3. Realizing of the forming ensembles in the creativity domain

The education of creativity opens the way of using a stimulant methodology, participative, which is based in essence not by the operation with one or two methods, but methodological composite, synthesis structures of educational action.

The analysis of the methodological frame for the contents of pre-university/ university brings a multitude of arguments in this sense [3, 4], at the same time with the request of growing the pedagogical culture of all the didactics.

Realizing of the forming ensembles in the creativity domain has in view specific knowledge, informational funds in the specialty literature, methods, techniques, heuristic demarches, and accessible heuristic-logical ones corresponding to the age and level of preparation. It is necessary, but not sufficient the knowledge of the independent, theoretic methods, demarches, but also their application in real contexts. Theoretical learning, without a concrete application can not lead to the stimulation or manifestation of creativity.

The frequent use in the lessons frame (teaching, learning, evaluation) and by consequent exercise leads, in time, to the formation of a *personal fund of creative demarches* [8] specific to the age, level or preparation, intellectual possibilities.

From the methods that can be used more frequently in didactical practice are: *brainstorming, sinectic, Ishikawa diagram (the cause – effect diagram), the method of the six hats, the morphological method, the mind – mapping method, questions lists* and techniques as: *amplification, diminution, multiplication, omission, divide, reordering, adapting, substituting, modification, schematization, analogy, empathy*.

4.4. Structural model of the knowledge system in the technological education

Having in view the tendencies of restructuring of the educational content and the development of a *generalized, systemic theory* which could be use in modeling various themes which cover the technological education domain, we propose a model of structuring *the knowledge system* which contains:

– *scalar type knowledge*: elementary knowledge, declarative, with immediate mental representation, axiomatic, in predefined context; by example: a dimension (moving, deviation), temperature, density, mass, etc.;

– *vector type knowledge*: mobilized scalar type knowledge (described, understood, used) by the human mind, on the basis of creativity techniques heuristic and logical-heuristic in real or imagined context; by example: speed, acceleration, force, electric field, power, etc.;

– *surface type knowledge*: vector type knowledge used with the computer help in real-theoretical context; by example: mechanism, actuator, bearing capacity, buildings grind resistance, etc.;

– *space type knowledge*: the culture in the domain, at a certain time; by example: designing in a field, quality approach, management, production system, etc.

The change at the level of didactical design imposed by national curriculum, requests to be accompanied by a change at the strategy level, class management, attitudes, and has in view going from the centering on the content on the centering on the student, which presumes moving the accent:

– from *theoretical aspects* (to know that…) to *applicative aspects* (to know to…);

– from *quantity* (as much…) to *quality* (how…);

– from a high volume of information, to *structured information* with bonds between them;

– from *teaching* to *learning*, the teacher's role being to intermediate the study;

– from the *traditional evaluation* to the one by *performance descriptors, individualized.*

The interdisciplinary applications, by using the obtained knowledge from technology, using invent specific means and the skills for use computer lead thoroughness of the knowledge, simultaneous use with the three domains, as well as an analysis/ research in the theme framework/ subject.

5. CONCLUSIONS

1. The technological education is a complex process, interdisciplinary, with various coordinates and needs a theoretical and applicative research on the measurement of the importance witch bonds over the economical and social environment.

2. The perfecting tendencies of the didactical methodology are centered on actively, communication and interaction, applicative character, formative, critical thinking, dimensions in which, the computer science and creativity in technological education have a determining role in the educational demarche.

3. The methodology proposed for the realization of various interdisciplinary activities "*technology – creativity – computer science*" define the knowledge system modularly organized, by elaborating some forming ensembles which contain study themes obtained by multiple combinations of objectives and knowledge.

4. The methodology proposed constitute a resource of creativity for the educational activity.

5. The use of the three concepts (technology, creativity, computer science) simultaneously, interdisciplinary, proposed in the paper can lead to the improvement of quality in technological education.

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